

ing over the extreme northwestern portion of that State and over several States north of Texas. The temperature in Texas at the time ranged from 16° F. over the panhandle to 74° F. along the coast. The disturbance that was over the lower

DO CLIMATES CHANGE?

Those who are interested in climatology, as distinguished from meteorology, should have their attention directed toward the numerous excellent articles published by Prof. R. De C.



FIG. 2.—Lenticular cumulus.

Rio Grande Valley moved east-northeast along the west Gulf coast to the Mississippi Valley and then moved northward. The cool wave, or norther, as they call it in Texas, struck Corpus Christi at 12:45 p. m. of the 19th, when the wind suddenly shifted from the east to the northwest, and rapidly increased in velocity, causing the temperature to fall nearly 20° F. in two hours. The accompanying dense black cloud, that always warns the inhabitants of an approaching norther, came from the west-northwest, which was unusual, as they almost invariably come from the north and northwest. The cool wave, or norther, did not reach Galveston, Tex., until about 11 p. m. of the 19th. From this it can be observed that the norther struck Galveston, a station located about 200 miles east and 100 miles north of Corpus Christi, ten hours after it struck the latter city, which is unusual, as they generally strike the former station about the same time and sometimes earlier than the latter.

The temperature at 8 p. m. of the 19th was 48° F. at Corpus Christi, while it was 74° F. at Galveston, and the writer, during his fourteen years' service in Texas, has never observed such conditions prior to this time.

The temperature at Corpus Christi fell from a maximum of 77° F. on the 19th to a minimum of 37° F. on the 20th. Such sudden and decided changes are rare over southern Texas. The minimum temperature at Corpus Christi on the morning of November 21 was 33° F., being the lowest temperature on record so early in the fall. Heavy frost occurred and thin ice formed almost to the Gulf shore. All tender vegetation, such as beans, cucumbers, and tomatoes, was killed in the vicinity of Corpus Christi, while cabbage, lettuce, beets, etc., were hardly damaged.

An amusing feature in connection with the cool wave was that there were many northern prospectors and homeseekers in Corpus Christi, and in conversation with citizens they would remark that they had been informed that it never froze and hardly ever frosted in southern Texas. Invariably the citizens would say: "It does not, but you people came down from the North and brought this with you".

Ward. Among these we have already noted a comprehensive series on the classification of climates.¹ In addition to this there is a paper on "Changes of climate", in the Popular Science Monthly for November; and a series of papers on "The characteristics of the zones", now being published in the Journal of Geography.

With regard to changes of climate Professor Ward says:

Changes of climate in the geological past are known with absolute certainty to have taken place: periods of glacial invasions as well as periods of more genial conditions. The evidence and the causes of these changes have been discussed and rediscussed by writers almost without number and from all points of view. Changes in the intensity of insolation, in the sun itself, in the condition of the earth's atmosphere, in the astronomical relations of earth and sun, in the distribution of land and water, in the position of the earth's axis, in the altitude of the land, in the presence of volcanic dust, changes now in cosmic now in terrestrial conditions, have been suggested, combated, put forward again. No one of these hypotheses has prevailed in preference to others. No actual proof of the correctness of this or that theory has been brought forward. No general agreement has been reached. Under these conditions, and in view of the fact that practical climatology is concerned with climatic changes not of the geological past but of the historical present, this portion of our subject may be dismissed with this brief mention.

There is a widespread popular belief in permanent, progressive changes of climate during a generation or two. This belief is not supported by the facts of meteorological record. Abundant evidence has been adduced in favor of secular changes of climate in historical times. Much of this is unreliable, contradictory, and has been interpreted without sufficient regard to possible controls other than climatic change. Without denying the possibility, or even the probability, of the establishment of the fact of secular changes, there is as yet no sufficient warrant for believing in considerable permanent changes over large areas. Dufour, after a thoro study of all available evidence, has concluded that a change of climate has not been proved. There are periodic oscillations of slight amount. An eleven-year period has been made out with more or less certainty for some of the meteorological elements, but it has been of no practical importance as yet. A thirty-five-year period is less uncertain, but is nevertheless of considerable irregularity, and can not as yet be practically applied in forecasting. Longer periods are suggested, but not made out. As to causes, variations in solar activity are naturally receiving attention, and the results thus far are promising. But climate is a great complex, and complete and satisfactory explana-

¹ Monthly Weather Review, September, 1906, Vol. XXXIV, p. 416.

tions of all the facts will be difficult, perhaps impossible, to reach. At present, indeed, the facts which call for explanation are still in most cases but poorly determined, and the processes at work are insufficiently understood. Climate is not absolutely a constant. The pendulum swings to the right and to the left. And its swing is as far to the right as to the left. Each generation lives thru a part of one or two or even three oscillations. A snap-shot view of these oscillations makes them seem permanent. As Supan has well said, it was formerly believed that climate changes locally, but progressively and permanently. It is now believed that oscillations of climate are limited in time, but occur over wide areas. Finally, it is clear that man, whether by reforestation or deforestation, by flooding a desert or by draining a swamp, can produce no important or extended modifications of natural climate, which is governed by factors beyond human control.

CLIMATOLOGICAL DATA FOR VIRGINIA.

Mr. Edward A. Evans, Section Director of the Climatological Service in Virginia, has published in the annual report of that section for the year 1905 a short index to the special articles which have been printed in the reports of that section, from the first issue in July, 1891, to the end of the year 1905. About forty titles are mentioned in the list; among them are the following:

Title.	Date of report.
Heated periods.....	July, August, 1900.
Hydrographs of James River at Richmond, Va.....	Annual, 1898-1905.
James River freshets.....	Annual, 1901.
Long-record meteorological data at various stations.....	January, 1904-February, 1905.
(Similar synopses are included in all issues to date of the year 1906.)	
Notes on James River freshet of April 21-22, 1901.....	April, 1901.
Notes on freshets in James River during 1902.....	Annual, 1902.
Precipitation, heavy, remarks on.....	June, August, 1901.
Report on thunderstorm at Lincoln, Va.....	June, 1903.
Table of James River freshets, 1893-1896.....	Annual, 1900.
Table of flood rises in James River, 1870 to 1892.....	Annual, 1900.

A list and accompanying map [not reproduced] are also given showing every station in Virginia at which meteorological observations are known to have been taken in the past, but are not now taken. This supplements the regular list and map which show only the stations now reporting to the section center. The list of almost a hundred discontinued stations gives the years which their records cover, and states whether the records comprise temperature or precipitation, or both.

The oldest record mentioned is the temperature record at Bellona Arsenal, Chesterfield County, for the years 1824 to 1833. This, unfortunately, like most others, is incomplete even for the years mentioned. The record at Fort Monroe is next in age, and is the longest record of all (1825 to 1874, for temperature, while the precipitation record is from 1836 to 1890); but again the record is incomplete. Other places with records extending over periods of fifteen years, or more, are Accotink, Birdsnest, Christiansburg, Falls Church, Goshen, Lewinsville, Mount Solon, Powhatan Hill, Smithfield, and Snowville.

Beginning with January, 1906, Mr. Evans has been printing each month in the section report a climatological summary of all data for stations having sufficient record to sum up in this way, together with a little text covering the general character of the record, names, and period of incumbency of observers, location and exposure of instruments, etc. This he finds useful in stimulating the interest of observers in keeping up their records.

LAND AND SEA WINDS.

Dr. Max. Kaiser, of Halle, Germany, has just published a memoir on "The Land and Sea Winds of the Baltic Coast of Germany". This appears as a dissertation for the attainment of the degree of doctor of philosophy, and has been prepared

under the special stimulus of Professor Doctor Brückner at the university, and also by the cooperation of Professor Doctor Köppen and Professor Doctor Grossmann of the Deutsche Seewarte at Hamburg, to which place Doctor Kaiser repaired in order to obtain the necessary observational data. In the preface to the present memoir the author regrets that we have so few special studies of the land and sea breezes in the temperate zones. He mentions, with especial approval, the work of Prof. William M. Davis of Harvard on the sea breezes of New England. Apparently Doctor Kaiser does not know of the elaborate memoir of Francis E. Loomis, the son of Prof. Elias Loomis, on the winds of New Haven, nor of the memoirs on the winds of our coast by Mr. T. H. Davis in the *MONTHLY WEATHER REVIEW*, Volume XXX, pages 261 and 519, which have been followed by another paper in the September Review. A great amount of material on this subject is also found in that monumental work, "The Winds of the Globe," by James H. Coffin, published by the Smithsonian Institution.

The studies of Doctor Kaiser relate to the years 1901-1905, and to anemograms registered at five stations on the German coast of the Baltic Sea, namely at Memel, Pillau, Neufahrwasser, Rugenwaldermunde, and Swinemunde. The coast line from the first to the last of these stations stretches from the east-northeast toward the west-southwest for about two hundred and fifty miles; it is a comparatively low and flat coast, like the country for a long distance to the southward and eastward. In connection with the observations of the wind the author has also studied the barometric gradient between the land and the water, using the daily barometric observations at the lightship off Adlergrund, which ship is about fifty miles from the coast and sixty miles north of the anemograph at Swinemunde. Much use was also made of the weather records kept on board many German ships traveling along this coast, and these enabled the author to get a clear idea of the conditions prevailing at the moment when the sea breeze began.

To give precision to our ideas Doctor Kaiser begins by stating that by land and sea breezes he understands only those that are caused by the differences in temperature between the land and the sea, and that change decidedly with the time of day. He has, therefore, with the help of the anemograms, selected those special days that show an appropriate change in the direction of the wind, and which the synoptic charts also show to have had small barometric gradients, feeble winds, and comparatively clear sky. On such days as these, which are the only ones that he studies for diurnal effects, the wind blows from the land in the early morning, but from the water between midday and the evening, and again from the land during the later evening. The beginning and the duration of the sea breeze is very variable; often it begins as early as 8 a. m., but often, also, as late as 2 p. m. The reason for this is to be found in peculiarities of temperature, of pressure, and of cloudiness, to which subject a large part of the memoir is devoted. On the average the duration of the sea breeze is longer during the summer months than during the rest of the year.

The velocity of the sea breeze, on the average, is from two to three meters per second. The maximum velocity occurs between 2 and 4 p. m., or near the time of the maximum temperature. The number of days on which the sea breeze, strictly so-called, occurs varies in any single month, for any single station, between 6 and 26 per cent of the number of days in the month; the following figures represent the average percentages of five years for the five stations along this part of the Baltic coast: April, 7; May, 13; June, 15; July, 19; August, 17; September, 14. The sea breeze does not occur in the remaining months from October to March, since during these months the sea is always warmer than the land, and there can therefore be no diurnal exchange of wind. In general the frequency of